

A FORTRAN PROGRAM WHICH AIDS IN GENERATING
MUTUAL INTERFERENCE CHARTS

Technical Report

No. ESD-TR-65-20

November 1965

Department of Defense
ELECTROMAGNETIC COMPATIBILITY ANALYSIS CENTER
A Joint Military Facility

Prepared by R. Fleck
of the IIT Research Institute

Published by
Electromagnetic Compatibility Analysis Center
U.S. Navy Marine Engineering Laboratory
Annapolis, Maryland 21402

20100812165

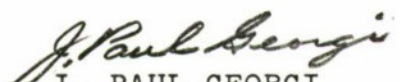
FOREWORD

The Electromagnetic Compatibility Analysis Center (ECAC) is a DOD facility, established to provide a data base, develop a rapid analysis capability and to provide analysis of electromagnetic compatibility projects of the military departments. The Center is under executive and administrative control of the Air Force and is located at the U.S. Navy Marine Engineering Laboratory, Annapolis, Maryland. The management and direction of the Center are provided by military and civil service personnel. The technical operations function is provided through an Air Force contract to the IIT Research Institute (IITRI).

This report was prepared as part of AF Project 649E under Contract AF 19(628)-5049 by the IIT Research Institute, ECAC, USNMEL, Annapolis, Maryland 21402.


Users of this report are invited to submit comments which would be useful in revising or adding to this material to the Director, ECAC, USNMEL, Annapolis, Maryland, Attention: ACL.

This report has been reviewed by:


J. PAUL GEORGI
Technical Director


S. I. COHN
Director of Technical Operations

Approved:


CHARLES C. WOOLWINE
Colonel, USAF
Director

When US Government drawings, specifications, or other data are used for any purpose other than a definitely related government procurement operation, the government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise, as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use or sell any patented invention that may in any way be related thereto.

Do not return this copy. When not needed, destroy in accordance with pertinent security regulations.

~~The distribution of this report is controlled. Qualified Defense Documentation Center users will request through ECAC.~~

The distribution of this report is limited because it provides insight into ECAC's capabilities and operations.

ERRATA

A Fortran Program Which Aids in Generating Mutual Interference Charts, ESD-TR-65-20, published by Electromagnetic Compatibility Analysis Center, November 1965.

Page 3-1, last paragraph, should read as follows:

The printed output consists of: receiver number, transmitter number, data on card 3, data on card 6, data on card 4, and the maximum values of P and HQ followed by the table of incompatible frequencies. In this table are listed the receiver and transmitter frequencies and the values of P and HQ. A sample printout is given in APPENDIX II.

ABSTRACT

This technical report presents a program for generating data for mutual interference charts and discusses the uses of such charts. Several examples are included.

KEY TERMS

FORTRAN
MUTUAL INTERFERENCE MATRIX
INTERFERENCE
PREDICTION

TABLE OF CONTENTS

SECTION 1

INTRODUCTION

SECTION 2

MATHEMATICAL APPROACH

SECTION 3

DISCUSSION OF THE PROGRAM

SECTION 4

APPLICATIONS AND SAMPLE PLOTS

LIST OF ILLUSTRATIONS

<u>Figure</u>		<u>Page</u>
1-1.	Sample Frequency Matrix	1- 2
4-1.	Mutual Interference Chart for Transmitter No. 2 versus Receiver No. 1	4- 2
4-2.	Mutual Interference Chart for Transmitter No. 1 versus Receiver No. 2	4- 3
4-3.	Mutual Interference Chart for Two Transceivers	4- 4

LIST OF APPENDIXES

Appendix

I	LISTING OF THE MIC GENERATION PROGRAM
II	SAMPLE OUTPUT

SECTION 1

INTRODUCTION

Transmitters radiate energy at harmonic frequencies as well as at the fundamental frequency. Receivers usually have a number of spurious responses as well as the tuned response. As a result of these unintentional emissions and responses, mutual interference may occur between two nonassociated equipments (interfering transmitter and victim receiver) even though their tuned frequencies are widely separated. Normally, interference resulting from a transmitter harmonic passing through a spurious response of a receiver occurs only when the two equipments are operated at the same site or are in close proximity to one another. To prevent the possibility of mutual interference in these cases, one should assign tuned frequencies to the equipments so that none of the transmitter harmonics are coincident in frequency with any of the spurious responses of the receiver.

The Electromagnetic Compatibility Analysis Center (ECAC) has implemented a mutual interference chart (MIC) generator that can be used as an aid in making frequency assignments for a particular transmitter and receiver (specified by nomenclature). The generator computes, for a given tuned frequency of the receiver, all of the tuned frequencies of the transmitter that may cause its fundamental or harmonics to be in frequency coincidence with one of the spurious responses of the receiver. The data resulting from the computations can be plotted in the form of a chart, in which the abscissa is the tuned frequency of the transmitter and the ordinate is the tuned frequency of the receiver. The plots on the chart show which tuned frequencies result in one of the receiver responses being coincident in frequency with either the fundamental or harmonic of the transmitter. It should be pointed out that even though an emission is coincident with one of the responses, the received signal may not be of sufficient amplitude to be detected or to cause interference, since signal level is not determined by the MIC generator. Some inference can be made, however, by considering the order of the interaction (see SECTION 2). It is also necessary to establish guardbands to take into account side band energy strong enough to interact with the receiver responses.

Two of the significant features of the mutual interference chart generator are:

1. Tables of incompatible frequencies can be produced for all transmitter-receiver combinations (by nomenclature). These tables can then be used to form charts which will aid in making

frequency assignments in situations where transmitter harmonics and receiver spurious responses must be taken into consideration.

2. The program has been written in FORTRAN, and thus can be used with any computer having a FORTRAN capability.

The mutual interference chart generator described in this report is a very useful tool that can be used by organizations involved in making frequency assignments and having a suitable computer available. Since the ratio of channel bandwidth to frequency spectrum for HF is very small, the charts must be quite large if adequate resolution is to be had. This makes their use somewhat awkward in this frequency range.

A technique that is commonly used to circumvent this problem is to plot an MIC containing only the "allocated set" of frequencies. That is, rather than plot all channels, only those channels available are placed on the chart.

As illustrated in Figure 1-1, the frequency set $f_1, f_2, f_3, \dots, f_N$ represents the available set. The entries in the matrix are the same as with a standard MIC.

		Transmitter Frequency				
		f_a	f_b	f_c	f_d	f_e
Receiver Frequency	f_1					
	f_2					
	f_3					
	f_4					
	f_5					

Figure 1-1. Sample Frequency Matrix

SECTION 2

MATHEMATICAL APPROACH

The MIC generator is based on the spurious response equation (2-1):

$$f_{sp} = \frac{Pf_{LO} \pm f_{IF}}{Q} \quad (2-1)$$

where

f_{sp} = an input frequency which causes a spurious response in the receiver.

f_{LO} = receiver local oscillator frequency.

f_{IF} = receiver first intermediate frequency.

P and Q are integers.

Since f_{sp} may equal a harmonic of the transmitter frequency, potential interfering fundamental frequencies may be found by:

$$f_t = \frac{f_{sp}}{H} = \frac{Pf_{LO} \pm f_{IF}}{HQ} \quad (2-2)$$

where

f_t = fundamental transmitter frequency.

H = integer representing harmonic number.

The FORTRAN program computes, for each receiver frequency, all possible solutions of equation (2-2) which are within the transmitter's tuning range. The process is repeated for several steps in receiver tuned frequency (input parameters). No levels are computed, but the significance of each response can be inferred from its order (P + HQ). As the order goes up, the responses tend to be less significant.

SECTION 3

DISCUSSION OF THE PROGRAM

Using $f_{LO} = (f_R + f_{IF})/M$, equation (2-2) can be rewritten as follows:

$$f_t = \frac{P}{HQ} \frac{f_R + f_{IF}}{M} \pm \frac{f_{IF}}{HQ} \quad (3-1)$$

where f_R is the receiver tuned frequency and M is the local oscillator multiplication factor. The maximum values which P and HQ take on in a given computation are input parameters. For all combinations of values up to these maximums, the potential interfering transmitter frequencies are calculated. Those frequencies which lie within the transmitter's tuning range are printed out and all others are discarded.

The program can handle up to 100 receivers and any number of transmitters on a single run. All transmitters will be run against all receivers. The only limiting factor is the quantity of printout, since provision is made for only one tape reel. When this is filled, the program will stop.

The program itself is given in APPENDIX I. The following data cards are required as inputs:

<u>Card No.</u>	<u>Format</u>	<u>Contents</u>
1	2I5	Number of receivers, number of transmitters.
2	I5	Receiver identification number.
3	3E20.8,2I5	First receiver tuned frequency, tuned frequency increments, intermediate frequency, L.O. multiplication factor, number of steps.
4	2I5	Maximum value of P , maximum value of HQ .
Repeat cards 1 - 4 for all receivers.		
5	I5	Transmitter identification number.
6	2E20.8	Lowest transmitter frequency, highest transmitter frequency.
Repeat cards 5 and 6 for all transmitters.		

The printed output consists of: receiver number, transmitter number, data on card 3, data on card 6, data on card 4, and the

table of incompatible frequencies. In this table are listed the receiver and transmitter frequencies and the values of P and HQ. A sample printout is given in APPENDIX II.

SECTION 4

APPLICATIONS AND SAMPLE PLOTS

As an example of the formation and use of MICs, two equipments with the following characteristics are assumed:

Equipment No. 1

Tuning range	1100-1300 mc
IF	60 mc
LO multiplication	1
Receiver identification number	11
Transmitter identification number	21

Equipment No. 2

Tuning range	200-400 mc
IF	27 mc
LO multiplication	3
Receiver identification number	12
Transmitter identification number	22

Transmitter No. 2 was run against receiver No. 1, and transmitter No. 1 was run against receiver No. 2. Receiver No. 1 was step-tuned in 50-mc increments and receiver No. 2 was step-tuned in 25-mc increments. The outputs for both runs are given in APPENDIX II and are plotted in Figures 4-1 and 4-2. Since receiver No. 2 has an LO multiplication factor of 3, spurious frequencies are computed by using the base LO frequency. This results in more potential response frequencies as can be seen from Figure 4-2. It can also be seen that each response follows a straight line as receiver and transmitter frequencies change. The slope of this line is:

$$\frac{\Delta f_t}{\Delta f_r} = \frac{P}{HQM} \quad (4-1)$$

where all terms are as previously defined.

Both plots in Figures 4-1 and 4-2 are of the one receiver-one transmitter type. If both equipments are transceivers (transmit and receive on the same frequency), Figures 4-1 and 4-2 are combined into one plot, producing Figure 4-3. In using either type of curve, it is necessary to remember that the lines represent incompatible frequency assignments. For example, from Figure

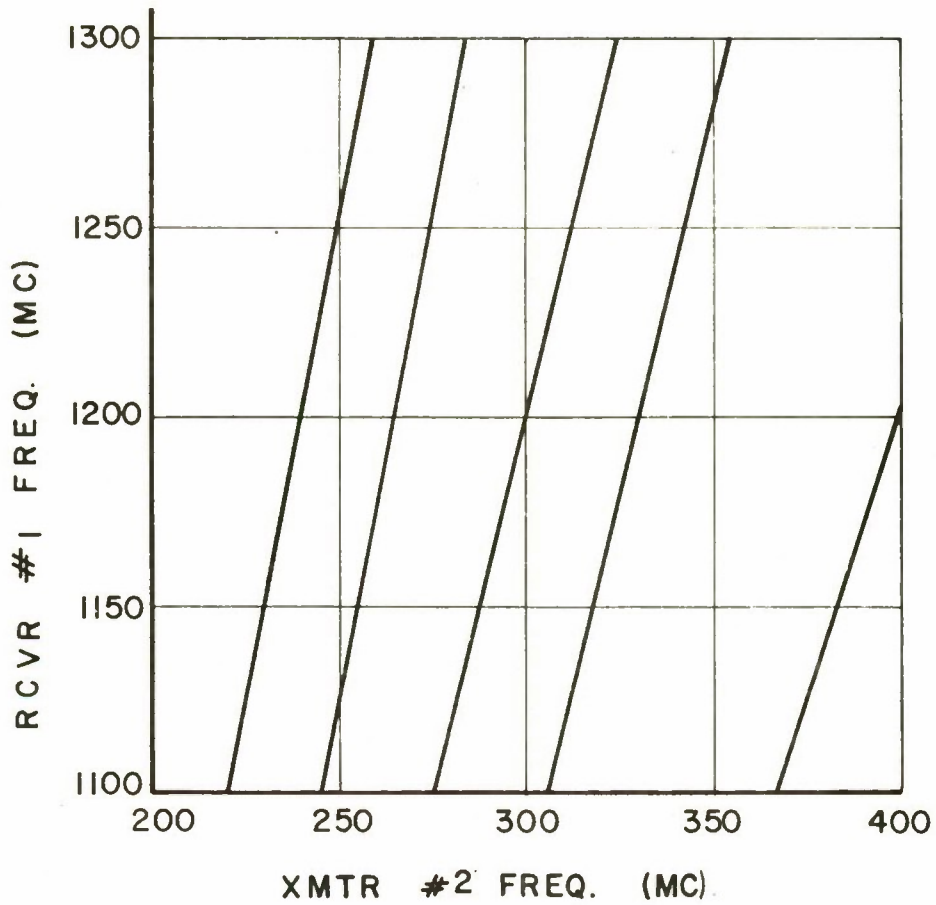


Figure 4-1. Mutual Interference Chart for Transmitter No. 2
versus Receiver No. 1

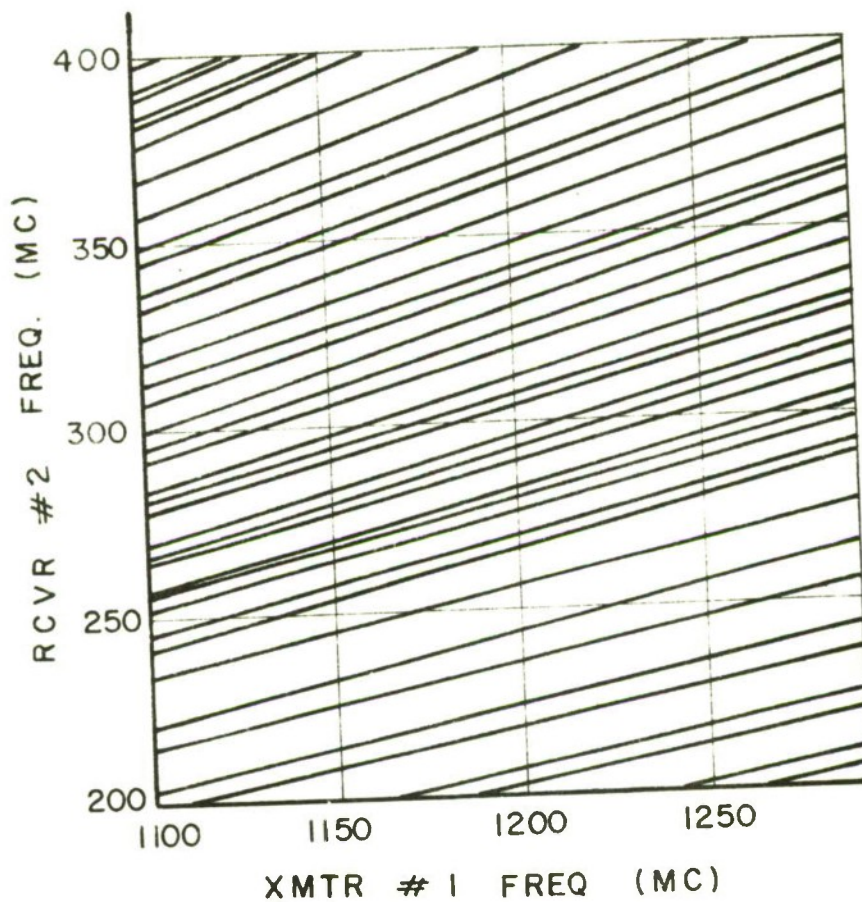


Figure 4-2. Mutual Interference Chart for Transmitter No. 1
versus Receiver No. 2

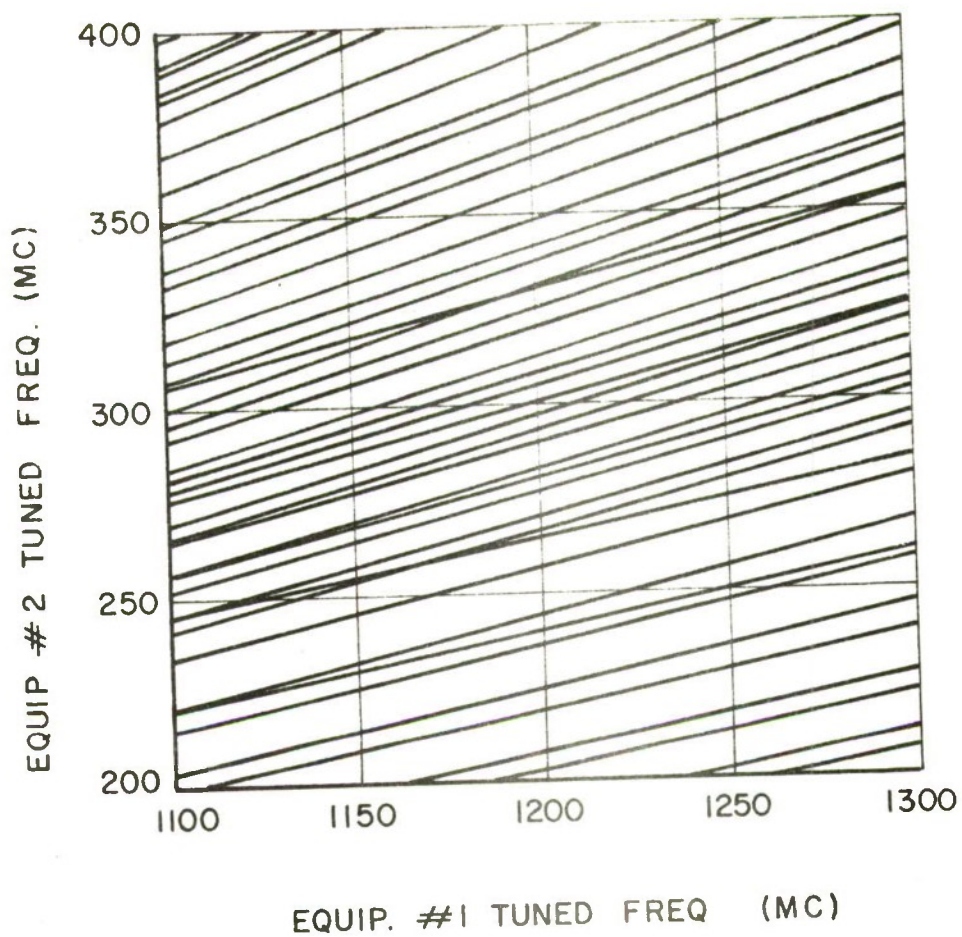


Figure 4-3. Mutual Interference Chart for Two Transceivers

4-1, transmitter No. 2 should not be tuned to 300 mc if receiver No. 1 is tuned to 1200 mc. Frequency assignments should be made by finding a pair of frequencies in an area with as few lines as possible. An example from Figure 4-3 is to tune equipment No. 1 to 1200 mc and equipment No. 2 to 250 mc.

APPENDIX I

LISTING OF THE MIC GENERATION PROGRAM

```

C      MIC GENERATION
-----
      DIMENSION NRCQ(100),FRQ(100),DELFQ(100),FIFQ(100),MQ(100),NCQ(100)
      1 ,MPQ(100),MHQ(100)
-----
      1 FORMAT (3E20.8,2I5)
-----
      2 FORMAT (2E20.8)
-----
      3 FORMAT (2I5)
-----
      11 FORMAT (/14X2HFT,18X2HFR,8X1HP,3X2HHQ/)
-----
      20 FORMAT (I5)
-----
      19 FORMAT (I5/, 3E20.8,2I5/,2I5)
      READ (5,3) NRX,NTX
      READ (5,19)(NRCQ(J),FRQ(J),DELFQ(J),FIFQ(J),MQ(J),NCQ(J),MPQ(J),
      1,MHQ(J), J=1,NRX)
      DO 18 JN=1,NTX
      READ (5,20) NTC
      READ (5,2) FTL,FTH
      DO 17 JK=1,NRX
      NRC= NRCQ(JK)
      FR=FRQ(JK)
      DELF = DELFQ(JK)
      FIF = FIFQ(JK)
      M= MQ(JK)
      NC= NCQ(JK)
      MP=MPQ(JK)
      MH=MHQ(JK)
      WRITE (6,20) NRC
      WRITE(6,20) NTC
      WRITE (6,1) FR,DELF,FIF,M,NC
      WRITE (6,2) FTL,FTH
      WRITE (6,3)MP,MH
      WRITE (6,11)
      AM=M
      F2=(FR+FIF)/AM
      DO 10 I=0,NC
      G=I
      F1 = G*DELF/AM
      FLO =F1+F2
      FRD=FR+G*DELF
      DO 10 J=0,MP
      P=J
      FSP = ABS(P*FLO + FIF)
      FSN = ABS(P*FLO - FIF)
      DO 9 L=1,MH
      H=L
      FTP = FSP/H
      FTN = FSN/H
      IF (FTP - FTL) 6,4,4
      4 IF (FTP - FTH) 5,5,6
      5 FORMAT (2E20.8,2I5)
      WRITE (6,5)FTP,FRD,J,L
      6 IF(FTN-FTL)9,7,7
      7 IF (FTN-FTH)8,8,9
      8 WRITE (6,5)FTN,FRD,J,L
      9 CONTINUE
      10 CONTINUE
      17 CONTINUE
      18 CONTINUE
      STOP

```

APPENDIX II
SAMPLE OUTPUT

PAGE 1		PRINTS LIST			
11					
22					
	.11000000+04	.50000000+02	.60000000+02	1	4
	.20000000+03	.40000000+03			
8	5				
FT	FR	P	HQ		
.36666666+03	.11000000+04	1	3		
.30500000+03	.11000000+04	1	4		
.27500000+03	.11000000+04	1	4		
.24400000+03	.11000000+04	1	5		
.22000000+03	.11000000+04	1	5		
.38333333+03	.11499999+04	1	3		
.31750000+03	.11499999+04	1	4		
.28749999+03	.11499999+04	1	4		
.25400000+03	.11499999+04	1	5		
.23000000+03	.11499999+04	1	5		
.40000000+03	.12000000+04	1	3		
.33000000+03	.12000000+04	1	4		
.30000000+03	.12000000+04	1	4		
.26400000+03	.12000000+04	1	5		
.23999999+03	.12000000+04	1	5		
.34250000+03	.12500000+04	1	4		
.31250000+03	.12500000+04	1	4		
.27400000+03	.12500000+04	1	5		
.25000000+03	.12500000+04	1	5		
.35500000+03	.13000000+04	1	4		
.32500000+03	.13000000+04	1	4		
.28399999+03	.13000000+04	1	5		
.26000000+03	.13000000+04	1	5		

PAGE 1 PRINTS LIST

12
21
.20000000+03 .25000000+02 .27000000+02 3 8
.11000000+04 .13000000+04
24 5

FT	FR	P	HQ
.11619999+04	.20000000+03	15	1
.11080000+04	.20000000+03	15	1
.12376666+04	.20000000+03	16	1
.11836666+04	.20000000+03	16	1
.12593333+04	.20000000+03	17	1
.11189999+04	.22499999+03	13	1
.12029999+04	.22499999+03	14	1
.11489999+04	.22499999+03	14	1
.12870000+04	.22499999+03	15	1
.12329999+04	.22499999+03	15	1
.11349999+04	.25000000+03	12	1
.12273332+04	.25000000+03	13	1
.11733333+04	.25000000+03	13	1
.12656666+04	.25000000+03	14	1
.11215000+04	.25000000+03	24	2
.11343333+04	.27500000+03	11	1
.12350000+04	.27500000+03	12	1
.11809999+04	.27500000+03	12	1
.12816666+04	.27500000+03	13	1
.11208333+04	.27500000+03	22	2
.11711666+04	.27500000+03	23	2
.11441666+04	.27500000+03	23	2
.12215000+04	.27500000+03	24	2
.11945000+04	.27500000+03	24	2
.11170000+04	.30000000+03	10	1
.12260000+04	.30000000+03	11	1
.11719999+04	.30000000+03	11	1
.12809999+04	.30000000+03	12	1
.11035000+04	.30000000+03	20	2
.11579999+04	.30000000+03	21	2
.11309999+04	.30000000+03	21	2
.12125000+04	.30000000+03	22	2
.11855000+04	.30000000+03	22	2
.12669999+04	.30000000+03	23	2
.12400000+04	.30000000+03	23	2
.12944999+04	.30000000+03	24	2
.12003333+04	.32500000+03	10	1
.11463333+04	.32500000+03	10	1
.12636666+04	.32500000+03	11	1
.11281666+04	.32500000+03	19	2
.11011666+04	.32500000+03	19	2
.11868333+04	.32500000+03	20	2
.11598333+04	.32500000+03	20	2
.12454999+04	.32500000+03	21	2
.12184999+04	.32500000+03	21	2
.12771666+04	.32500000+03	22	2

PAGE 2

PRINTS LIST

.11579999+04	.34999999+03	9	1
.11039999+04	.34999999+03	9	1
.12836666+04	.34999999+03	10	1
.12296666+04	.34999999+03	10	1
.11444999+04	.34999999+03	18	2
.11174999+04	.34999999+03	18	2
.12073333+04	.34999999+03	19	2
.11803333+04	.34999999+03	19	2
.12701666+04	.34999999+03	20	2
.12431666+04	.34999999+03	20	2
.12329999+04	.37500000+03	9	1
.11789999+04	.37500000+03	9	1
.11524999+04	.37500000+03	17	2
.11254999+04	.37500000+03	17	2
.12194999+04	.37500000+03	18	2
.11924999+04	.37500000+03	18	2
.12864999+04	.37500000+03	19	2
.12594999+04	.37500000+03	19	2
.11656667+04	.40000000+03	8	1
.11116666+04	.40000000+03	8	1
.12539999+04	.40000000+03	9	1
.11521666+04	.40000000+03	16	2
.11251666+04	.40000000+03	16	2
.12233333+04	.40000000+03	17	2
.11963332+04	.40000000+03	17	2
.12944999+04	.40000000+03	18	2
.12674999+04	.40000000+03	18	2
.11002222+04	.40000000+03	23	3
.11476666+04	.40000000+03	24	3
.11296666+04	.40000000+03	24	3

UNCLASSIFIED

Security Classification

DOCUMENT CONTROL DATA - R&D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Electromagnetic Compatibility Analysis Center, USNMEL, Annapolis, Maryland		2a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED	
		2b. GROUP	
3. REPORT TITLE A FORTRAN PROGRAM WHICH AIDS IN GENERATING MUTUAL INTERFERENCE CHARTS			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates)			
5. AUTHOR(S) (Last name, first name, initial) Fleck, R.			
6. REPORT DATE November 1965		7a. TOTAL NO. OF PAGES 20	7b. NO. OF REFS 0
8a. CONTRACT OR GRANT NO. AF 19(628)-5049		8a. ORIGINATOR'S REPORT NUMBER(S) ESD-TR-65-20	
b. PROJECT NO. 649E			
c.		9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)	
d.			
10. AVAILABILITY/LIMITATION NOTICES This Document has Been Approved for Public Release and Sale, Its Distribution is unlimited. Qualified Defense Unlimited by ECAC.			
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY Department of Defense	
13. ABSTRACT This technical report presents a program for generating data for mutual interference charts and discusses the uses of such charts. Several examples are included.			

III-1

14.

KEY WORDS

LINK A

ROLE

WT

LINK B

ROLE

WT

LINK C

ROLE

WT

FORTRAN
MUTUAL INTERFERENCE MATRIX
INTERFERENCE
PREDICTION

INSTRUCTIONS

1. **ORIGINATING ACTIVITY:** Enter the name and address of the contractor, subcontractor, grantee, Department of Defense activity or other organization (*corporate author*) issuing the report.

2a. **REPORT SECURITY CLASSIFICATION:** Enter the overall security classification of the report. Indicate whether "Restricted Data" is included. Marking is to be in accordance with appropriate security regulations.

2b. **GROUP:** Automatic downgrading is specified in DoD Directive 5200.10 and Armed Forces Industrial Manual. Enter the group number. Also, when applicable, show that optional markings have been used for Group 3 and Group 4 as authorized.

3. **REPORT TITLE:** Enter the complete report title in all capital letters. Titles in all cases should be unclassified. If a meaningful title cannot be selected without classification, show title classification in all capitals in parentheses immediately following the title.

4. **DESCRIPTIVE NOTES:** If appropriate, enter the type of report, e.g., interim, progress, summary, annual, or final. Give the inclusive dates when a specific reporting period is covered.

5. **AUTHOR(S):** Enter the name(s) of author(s) as shown on or in the report. Enter last name, first name, middle initial. If military, show rank and branch of service. The name of the principal author is an absolute minimum requirement.

6. **REPORT DATE:** Enter the date of the report as day, month, year; or month, year. If more than one date appears on the report, use date of publication.

7a. **TOTAL NUMBER OF PAGES:** The total page count should follow normal pagination procedures, i.e., enter the number of pages containing information.

7b. **NUMBER OF REFERENCES:** Enter the total number of references cited in the report.

8a. **CONTRACT OR GRANT NUMBER:** If appropriate, enter the applicable number of the contract or grant under which the report was written.

8b, 8c, & 8d. **PROJECT NUMBER:** Enter the appropriate military department identification, such as project number, subproject number, system numbers, task number, etc.

9a. **ORIGINATOR'S REPORT NUMBER(S):** Enter the official report number by which the document will be identified and controlled by the originating activity. This number must be unique to this report.

9b. **OTHER REPORT NUMBER(S):** If the report has been assigned any other report numbers (*either by the originator or by the sponsor*), also enter this number(s).

10. **AVAILABILITY/LIMITATION NOTICES:** Enter any limitations on further dissemination of the report, other than those

imposed by security classification, using standard statements such as:

- (1) "Qualified requesters may obtain copies of this report from DDC."
- (2) "Foreign announcement and dissemination of this report by DDC is not authorized."
- (3) "U. S. Government agencies may obtain copies of this report directly from DDC. Other qualified DDC users shall request through _____."
- (4) "U. S. military agencies may obtain copies of this report directly from DDC. Other qualified users shall request through _____."
- (5) "All distribution of this report is controlled. Qualified DDC users shall request through _____."

If the report has been furnished to the Office of Technical Services, Department of Commerce, for sale to the public, indicate this fact and enter the price, if known.

11. **SUPPLEMENTARY NOTES:** Use for additional explanatory notes.

12. **SPONSORING MILITARY ACTIVITY:** Enter the name of the departmental project office or laboratory sponsoring (*paying for*) the research and development. Include address.

13. **ABSTRACT:** Enter an abstract giving a brief and factual summary of the document indicative of the report, even though it may also appear elsewhere in the body of the technical report. If additional space is required, a continuation sheet shall be attached.

It is highly desirable that the abstract of classified reports be unclassified. Each paragraph of the abstract shall end with an indication of the military security classification of the information in the paragraph, represented as (TS), (S), (C), or (U).

There is no limitation on the length of the abstract. However, the suggested length is from 150 to 225 words.

14. **KEY WORDS:** Key words are technically meaningful terms or short phrases that characterize a report and may be used as index entries for cataloging the report. Key words must be selected so that no security classification is required. Identifiers, such as equipment model designation, trade name, military project code name, geographic location, may be used as key words but will be followed by an indication of technical content. The assignment of links, rules, and weights is optional.

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS ELECTRONIC SYSTEMS DIVISION (AFSC)
LAURENCE G. HANSCOM FIELD, BEDFORD, MASSACHUSETTS 01730



REPLY TO
ATTN OF: ESE(Mr. O'Brien/5322)

7 October 1968

SUBJECT: Review of Technical Document

TO: ESTIP

Identification: ESD-TR-68-404, ESD-TR-65-20, ESD-TR-67-380,
ESD-TR-68-292, ESD-TR-67-411, and ESD-TR-68-290.

ESE has no objection to release of the above-cited documents
to the Clearinghouse for Scientific and Technical Information.

John T. O'Brien
JOHN T. O'BRIEN
Chief, Public Information Division,
Information Office

6 Atch
n/c